Commentary

Oxygen Saturation: A Fifth Vital Sign?

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Change is upon us. On rounds of teaching hospitals around the country, an evolution has occurred in the way residents and students present the cases of patients—the addition of reporting patients' oxygen saturation as part of the vital signs. In an assessment of 100 cases presented at the University of California, San Francisco, School of Medicine, 86% included this information.

Historically, the pulse and respiratory rate were the initial vital signs because their determination did not rely on any instrument other than a timepiece. Body temperature, blood pressure, and oxygen saturation determination require instruments and, strictly speaking, should be considered diagnostic tests rather than vital signs. The addition of all three to the pulse and respiratory rate has occurred because the instruments used—thermometer, sphygmomanometer, and finger oxygen monitor—are inexpensive, reusable, and noninvasive. Indeed, the information derived from all five reflects crucial physiologic functioning.

Although the invention of the thermometer is attributed to Galileo between 1593 and 1597, Sanctorius of Padua was the first to describe in print in about 1625 the use of a thermometric apparatus.[1,2] By 1740 several investigators, including Newton, attempted to standardize thermometric instruments. Systematic thermometry did not gain widespread acceptance in the medical profession, however, until Lord Kelvin established his "absolute scale of temperature" in 1849 and Wunderlich between 1857 and 1865 taught the clinical utility of the thermometer.[3] Over the past century, the reporting of patients' temperatures has become a vital part of the case presentation.

Clinical sphygmomanometry was first described in the late 19th century. The determination of the blood pressure combines external compression, measurement by a manometer, and the auscultation of sounds to indicate systolic and diastolic phase changes of blood flow in an artery. Marey in 1876 and von Basch in 1881 were the first to describe instruments that combined external compression with the measurement of pressure by a manometer. Riva-Rocci and others continued to improve on this apparatus over the next 25 years until Korotkoff in 1905 added auscultation—making the measurement of the blood pressure complete.[4] The blood pressure measurement has since remained an essential part of case presentations.

Oxygen saturation determination, compared with the other vital signs, is new. The technique of using pulsatile light variation to measure arterial oxygen saturation was not developed until 1972, when it was described by Takuo Aoyagi of Japan.[5–7] The pulse oximeter was introduced in the early 1980s as an accurate, precise, noninvasive measurement of arterial hemoglobin oxygen saturation.[8] The technique involves "sandwiching" a patient's arterial vascular bed between a light source and a detector. Light of two or more specific wavelengths is transmitted through the blood, and the amount of light absorbed is measured. The arterial oxygen saturation is then calculated from the difference in absorption at the two wavelengths.[9,10]

Pulse oximetry is useful in most in-hospital patients and in ambulatory patients with lung disease. It is a relatively inexpensive and readily available method of assessing a patient's oxygenation. Other than pulse oximetry, the only practical way to assess oxygenation is by percutaneous arterial puncture (the "blood gas" values). This technique requires trained personnel, a blood gas analyzer, and substantial discomfort for the patient. Thus, the oxygen saturation provides clinicians with critical information that is readily obtainable.

Three limitations related to pulse oximetry deserve mention. First, although the measurement of arterial oxygen saturation by pulse oximetry is relatively accurate,[11] oxygen delivery as measured by saturation may occasionally lead to an erroneous conclusion concerning its clinical relevance. An oxygen saturation of 88% approximates a partial pressure of oxygen (Po_2) of 60 mm of mercury; even small decrements thereafter reflect considerable reductions in tissue oxygen delivery. Although most physicians know this, occasionally a novice may incorrectly assume that the numerical oxygen saturation has importance similar to the Po_2 of the same number. Second, the pulse oximeter does not allow for the assessment of the blood pH or partial pressure of carbon dioxide (Pco_2)—two measures routinely

(Tierney LM Jr, Whooley MA, Saint S. Oxygen saturation: a fifth vital sign? West J Med 1997 Apr; 166:285–286)

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obtained from the arterial blood gas measurement. If these values are important in the care of a patient, a pulse oximetry measurement alone would be suboptimal. Finally, a less important but nevertheless annoying trend is germinating. Pulse oximetry has led to a neologism in a field already oversaturated with them, this being the intransitive verb "to sat." This is typically expressed as follows: "The patient was 'satting' at 93%." Every effort should be made to discourage the use of this jargon. Despite these problems, it is noteworthy to speculate that a "fifth vital sign" may be available.

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Korean Morning

Shimmering dawn on our
Marine tent hospital.
Earlier we slept soothed by the
tympany of an all night deluge.
Pines dripping, water droplets on sword ferns,
scallions fused with the pungency
of dung-fertilized soil.
Jumping frogs in erotic frenzy
swarmed in viridescent mounds.

Private McCabe grabbed a Chinese
before he could stab Dr Ed Raney.
McCabe and Corporal Hansen grappled
six more assassins
in the doctors' tent that night.

Morning: the big guns and rifles resounding
I foresaw gaping wounds
exuding virulent mud.
First I contemplated
the throbbing and croaking
green mounds.

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